Biomass and Alternative Methane Fuels (BAMF)
Super ESPC Program
Fact Sheet

Leading by example, saving energy and taxpayer dollars in federal facilities

Wastewater Treatment Gas to Energy for Federal Facilities

Industry Snapshot

The average American creates about 100 gallons of wastewater every day. Wastewater is composed of 99.94 percent water and must be treated and purified before it can be reintroduced into the environment.

Reciprocating engine fueled with digester gas at work in Washington State. (Photo courtesy of King County, Washington.)

Wastewater treatment in larger facilities involves anaerobic digestion where, in the absence of oxygen, bacteria digest residual solids and create methane gas as a byproduct. This gas can be converted to significant amounts of energy and with minimal processing can be used as a substitute for natural gas.

There are more than 16,000 wastewater treatment plants (WWTPs) in the United States ranging in size from multi-billion-dollar complexes to small, single-community plants. About 3500 of these facilities, mainly the larger ones, employ anaerobic digestion. Since methane is a by-product of digestion, many treatment plants use the gas to supply heat needed to complete the digestion process, but only 2 percent of these plants use the digester gas to produce electricity. Most of these plants could produce power from the gas and still heat their digesters with the waste heat from the generation process.

Applications

Wastewater digester gas can serve as a fuel substitute for natural gas in applications such as boilers, hot water heaters, reciprocating engines, turbines, and fuel cells. The gas produced by anaerobic digestion is usually

The BAMF Super ESPC

Federal Agencies can use energy savings performance contracts (ESPCs) to finance their energy projects, allowing them to reduce their energy use and costs without depending on Congressional appropriations to fund the improvements. Using FEMP's Super ESPCs, agencies can partner with prequalified, competitively selected energy services companies (ESCOs) and use an expedited contracting process to implement their projects quickly. Federal facilities worldwide can use the Technology-Specific Biomass and Alternative Methane Fuels (BAMF) Super ESPC, which offers financing and private-sector expertise specifically geared to using renewable BAMF resources.

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more than 60 percent methane, and some plants with state-of-the-art facilities have the potential to produce a biogas with concentrations of methane that reach up to 95 percent. This biogas is produced on a continuous basis, and contaminants, such as hydrogen sulfide, are removed prior to use. Other processing may include dehydration, filtering, or CO_2 removal.

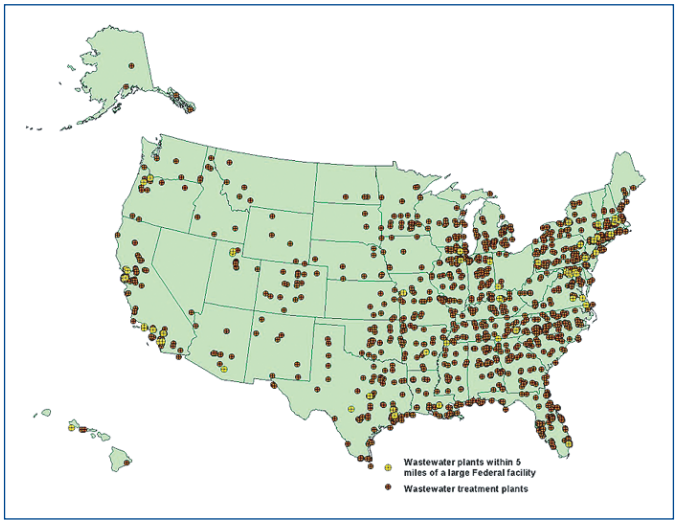
The most common use of wastewater treatment methane is for internal process heat used in the wastewater digesting process. The heat can be provided directly or by producing steam in a boiler. The most popular method for converting wastewater treatment gas to electricity is using internal-combustion engines that run a generator to produce electricity, which is generally used to power internal operations with the excess electricity being sold back to the grid. Heat generated by these engines can also be recovered and used to heat digesters and plant facilities, thus improving overall system efficiency. Another proven application employs microturbines to produce electricity. Microturbine systems can be modularized and easily expanded as gas production increases.

Biogas is being used to fuel new technologies such as fuel cells and Stirling engines. Some fuel cells operating on wastewater digester methane produce up to 2 megawatts of electricity. The Stirling engine is attractive for this application because it is an external combustion engine and does not require the degree of gas cleanup that other technologies require. Stirling engines can also be modularized.

Potential for Using Wastewater Digester Gas to Produce Energy in Federal Facilities

A recent study found that there are about 140 wastewater treatment plants with anaerobic digesters processing more than 3 million gallons per day that are within 5 miles of large federal facilities. (Anaerobic digesters are generally used when wastewater flow is greater than 3 million gallons per day.) Data obtained from the EPA's database of Water Discharge Permits indicate that more than 1600 wastewater treatment plants and nearly 800 federal facilities are located within fifteen miles of each other.

Federal energy managers should be aware of two types of opportunities to undertake WWTP-biogas-to-energy projects. For large federal facilities that have their own treatment plants, numerous possibilities to save on energy, water, or related operating costs (including sludge removal) should be considered. In addition to the types of energy generation projects discussed above, other improvements related to wastewater processing could be financed through the BAMF Super ESPCs. Federal facilities that are near a municipal WWTP (within 15 miles) should explore whether the plant is of sufficient size to produce excess biogas, the availability of the biogas, and what end-use application would make economic sense.



Location of large wastewater treatment plants.

Benefits of Wastewater Digester Gas for Federal Facilities

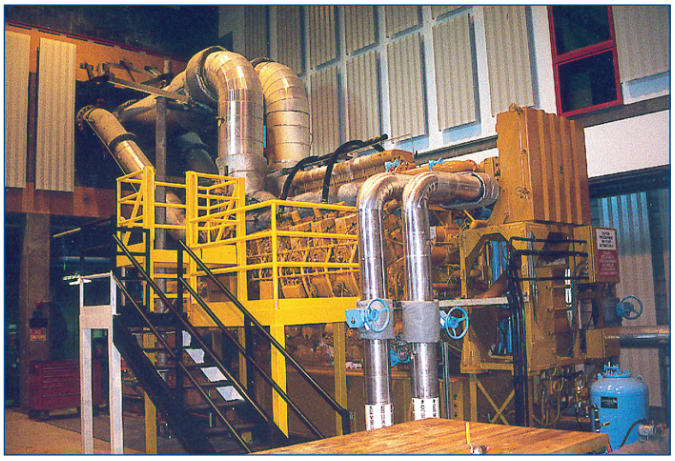
- Energy cost savings from the utilization of waste gas
- Stabilized energy costs and protection from volatility of gas and electricity prices
- Progress toward federal goals for use of renewable energy
- Enhanced energy security — reduced vulnerability to power grid interruptions
- Reduced emissions that result from flaring

Examples of Successful Wastewater-to-Energy Applications

Point Loma Wastewater Treatment Plant

The Point Loma Plant serves a 450-square-mile area in and near San Diego, California, and has a capacity of 240 million gallons per day. The plant is energy-self-sufficient and sells excess energy in the form of electricity to the grid.

The plant has eight digesters that break down the organic solids removed from the wastewater, producing methane gas that is collected, cleaned, and piped to the on-site gas



Heat and power from a reciprocating engine fueled with digester gas. (Photo courtesy of the San Diego Wastewater Treatment Dept.)

utilization facility. The gas is then used to provide space heating and cooling. The methane produced by the digesters also fuels two internal-combustion reciprocating engines that run generators with a total capacity of 4.5 megawatts. Heat produced by the operation of the engines is used to heat the digesters for optimum performance in the generation of gas. The generated electricity runs process pumps, lights, and computers. In 2000, the city of San Diego saved more than $3 million in operational energy costs and was able to sell $1.4 million worth of excess power to the electrical grid.

King County, Washington, Wastewater Treatment Division Generates Electricity with Fuel Cells and Reciprocating Engines

The Wastewater Division of the King County (Seattle) Department of Natural Resources is using methane derived from wastewater digester gas at two of their operations to produce electricity and process heat. Their largest facility, the West Point Treatment Plant, processes 133 million gallons per day. The South Treatment Plant processes more than 115 million gallons per day.

The West Point Wastewater Treatment Plant serves a 126-square-mile area with a population of 670,000. The anaerobic digesters at the plant produce 1.4 million cubic feet of digester gas per day. The plant uses boilers, engine-driven pumps, and three internal-combustion engines that each run a 1300-kilowatt generator. They typically run two generators at a time to produce 1.5 – 2 megawatts of electricity, which is sold to the local utility, Seattle City Light. The West Point plant also uses digester gas as the primary fuel for their influent pumps. Exhaust heat from the engines is used to heat the digesters and the plant.

The South Treatment Plant occupies 95 acres in Renton, Washington, south of Seattle, and serves a population of 730,000 in the Puget Sound region. Until recently, the plant scrubbed (cleaned) their digester gas to pipeline quality and sold it to Puget Sound Energy. In 2003-2004 the South plant installed a 1-megawatt molten carbonate fuel cell. By 2005 the fuel cell will be running in combination with two 3.5-megawatt turbine generators. Heat from the turbine exhausts will be used in their digesters. The combination of pipeline-quality gas and on-site electricity production gives this plant the flexibility to use their methane for optimum economic gain.

Rules of Thumb

- A typical WWTP facility processes 1 million gallons per day (MGD) of wastewater for every 10,000 in population served.
- Anaerobic digesters are generally used when wastewater flow is greater than 3 MGD.
- For each MGD processed by a plant with anaerobic digesters, the available biogas can generate up to 35 kW.
- The heating value of the gas produced from the anaerobic digesters is nominally 60 percent that of natural gas (1000 Btu per cubic foot), but with maximum digestion and proper cleanup can be increased to as much as 95 percent.
- Project viability is more probable for facilities that are within 15 miles of a wastewater treatment plant.

West Point Wastewater Treatment Plant. (Photo courtesy of King County, Washington.)

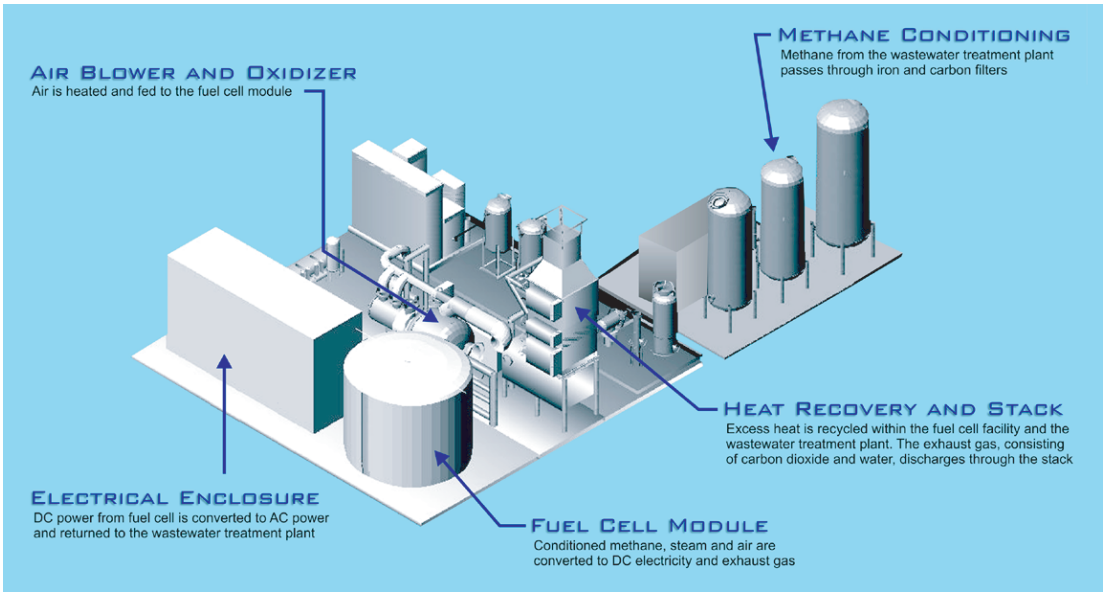


Diagram of a 1-MW molten carbonate fuel cell installed at Seattle's South Wasterwater Treatment Plant. (Diagram courtesy of King County, Washington.)

For More Information

To find out more about the opportunities for turning waste to energy using the BAMF Super ESPC, visit the FEMP web site at www.eere.energy.gov/femp/financing/superespcs_biomass.cfm or contact the FEMP representative at the DOE Regional Office for your area. Also, the following can provide information on the BAMF Super ESPC:

Christopher Abbuehl
National Program Representative
215-656-6995
christopher.abbuehl@ee.doe.gov

Craig Hustwit
Technical Lead
412-386-4532
craig.hustwit@netl.doe.gov

Danette Delmastro
FEMP
BAMF Team Leader
202-586-7632
danette.delmastro@ee.doe.gov

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